

## CAROL D. FROST

Department of Geology and Geophysics  
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### EDUCATION

- 1984 Ph.D. Earth Sciences, University of Cambridge  
Isotopic evolution of continental crust: granite petrogenesis and sediment recycling  
Supervisor: Prof. R. K. O'Nions
- 1979 A.B., *magna cum laude*, Dartmouth College, Highest Distinction in Earth Sciences  
Geochronology and depositional environment of a Late Pliocene age Siwalik sequence  
enclosing several volcanic tuff horizons, Pind Savikka area, eastern Salt Range, Pakistan  
Advisor: Dr. G. D. Johnson

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### ACADEMIC AND ADMINISTRATIVE POSITIONS

- 2014-present Division Director, National Science Foundation Division of Earth Sciences
- 1983-present Department of Geology and Geophysics, University of Wyoming: Assistant  
Professor (1983-1989), Associate Professor (1989-1995), Professor (1995-present)
- 2012-2013 Associate Provost, Office of Academic Affairs, University of Wyoming
- 2010-2012 Vice President for Special Projects, Office of the President, Univ. of Wyoming
- 2008-2010 Associate Vice President for Research, University of Wyoming
- 2006-2007 Founding Director, School of Energy Resources, University of Wyoming
- 2005-2008 Associate Chair, Dept. of Geology and Geophysics, University of Wyoming
- 2004-2005 Visiting Researcher, Institut für Mineralogie, Universität Hannover
- 1990-1991 Visiting Researcher, Department of Earth Sciences, University Cambridge, and  
Life Fellow (#518), Clare Hall, Cambridge
- Fall 1987 Visiting research scientist, Laboratory of Isotope Geochemistry, Eidgenössische  
Technische Hochschule, Zurich

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### HONORS AND AWARDS

- 2013 National Ski Patrol Purple Merit Star for saving the life of a heart attack victim while  
rock climbing at Vedauwoo Crags, Wyoming in June 2013
- 2008 George Duke Humphrey Award, University of Wyoming (UW's highest faculty  
award honoring extraordinary teaching, scholarship and service)
- 2007 Extraordinary Merit in Research, College of Arts & Sciences, Univ. of Wyoming
- 2007 "Top Ten Teacher," College of Arts & Sciences, University of Wyoming
- 2003 Extraordinary Merit in Research, College of Arts & Sciences, Univ. of Wyoming
- 2001 Carnegie Foundation/CASE Wyoming Professor of the Year
- 2000-2001 Ellbogen Meritorious Classroom Teaching Award, University of Wyoming
- Fall 2000 Presidential Speaker, University of Wyoming: "Fingerprints on Wyoming's Rock of  
Ages: Clues to the Growth of Continents"
- 1998-1999 Extraordinary Merit in Teaching, College of Arts & Sciences, Univ. of Wyoming
- 1998 Fellow, Mineralogical Society of America

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## RECENT COMMUNITY SERVICE

2013	Community outreach video presentation on the Sherman granite at Vedauwoo Crags, Wyoming, accessible by QR code from forest service information sign.
2011-2013	President, Phi Beta Kappa Alpha of Wyoming
2013-2014	Vice President, Educational Health Center of Wyoming Board of Directors
2011-2014	Wyoming State Geological Survey Advisory Board member, Vice President, President
2007-2010	Councilor, Mineralogical Society of America
2005-2006	Search Committee, President of the University of Wyoming
2005-2009	Governor's appointee to the Board of Professional Geologists, State of Wyoming; Secretary-Treasurer of the Board 2006-2009
2005-2010	Co-chair, UNESCO project IGCP-510 "A-type granites and related rocks through time." Hold annual workshops and field trips for international group of scientists
May 2005	Leader, Goldschmidt Conference 5-day field trip, "Extrusive rocks of the Snake River Plain-Yellowstone hotspot track" for 28 participants from 12 countries
1998-2003	Public information subcommittee, Environmental Advisory Committee, City of Laramie
Oct. 2000	UW organizer of joint UW/Wyoming Geological Survey/Wyoming Geological Association Fall Conference: "Coalbed methane in the Powder River Basin"
2000-03, 2007-13	Presentation on "Geology of Wyoming" to Leadership Wyoming class, a group of state leaders organized by UW and the Wyoming Business Alliance
Oct. 1999	UW organizer of joint UW/Wyoming Geological Survey/Wyoming Geological Association Fall Conference: "Geology of Wyoming and surrounding areas"
July 1999	Speaker at the UW/NPS Research Center in Grand Teton National Park to audience of 130 scientists, local residents and tourists: "The oldest rocks of Wyoming: nucleus of North America"

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## PROFESSIONAL AFFILIATIONS AND ACTIVITIES

### Lectureships

Fall 2000	Presidential Speaker, University of Wyoming
1997-1998	Mineralogical Society of America Lecturer

### Review/editorial boards

2009-2013	Science Editor, <i>Geosphere</i>
2005-2009	Associate Editor, <i>Geosphere</i>
1994-1996	Associate Editor, <i>Geological Society of America Bulletin</i>
1991-1993	Editorial Board, <i>Geology</i>

### Grant review panels

2011	Panel member, Tectonics, National Science Foundation
2008	Panel member, Post-doctoral Fellowships and Research Experience for Undergraduates, National Science Foundation
2007	Panel member, Research Experience for Undergraduates, National Science Foundation

- 2000-2003      Panel member, Solid Earth Sciences, and Chair, Major Equipment for Solid & Environmental Earth Sciences, Canadian National Science & Engineering Research Council
- 1994-1996      Panel member, Petrology and Geochemistry, National Science Foundation
- 1993-1994      Panel member, Graduate Fellowships, National Science Foundation
- 1992,1994      Panel member, Churchill Foundation Fellowships, University of Cambridge

**Co-Editor**, *Sixth Hutton Symposium on the Origin of Granites and Related Rocks*, Geological Society of America Special Paper 472 edited by J.D. Clemens, C. Donaldson, C.D. Frost, A.F.M. Kisters, J.-F. Moyaen, T. Rushmer, and G. Stevens, 2010.

**Guest editor**, *Rocky Mountain Geology*

Special issue on carbon dioxide sequestration, October 2010

**Guest editor**, *Lithos*

A-type granites and related rocks through time, 2007 and 2012

**Guest editor**, *Canadian Journal of Earth Sciences*

Special issue on the Wyoming Province, October 2006

**Guest editor**, *Rocky Mountain Geology*

Special issues on Proterozoic magmatism: v. 34, no. 2 (Fall 1999), v. 35, no. 1 (Spring 2000)

#### **Offices in professional societies**

- 2014-2015      Petrology Theme Co-chair, Program Committee, Goldschmidt 2015
- 2012-2014      Joint Technical Program Committee, Geological Society of America
- 2007-2010      Councilor, Mineralogical Society of America (elected position)
- 2004-2007      Fellows nominations committee, Mineralogical Society of America
- 2003-2006      Nominations committee, Geochemical Society
- 2000-2002      Public Service Award committee, Mineralogical Society of America
- 1990-1993      Goldschmidt Medal committee, Geochemical Society

**Licensure**      Licensed Professional Geologist, State of Wyoming PG-2591

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#### **TEXTBOOK**

Frost, B.R., and Frost, C.D., 2014, *Essentials of Igneous and Metamorphic Petrology*, Cambridge University Press, ISBN 978-1-107-02754-1.

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#### **PUBLICATIONS**

Frost, C.D., 2014, Mapping the Teton Range. *Rocky Mountain Geology*, 42, 198.

Duke, G.I., Carlson, R.W., Frost, C.D., Hearn, B.C., Eby, G.N., 2014, Continent-scale linearity of kimberlite-carbonatite magmatism, mid-continent North America. *Earth and Planetary Science Letters*, 403, 1-14.

Quillinan, S., Frost, C.D., 2014, Carbon isotope characterization of Powder River Basin Coal Bed Waters: Key to minimizing unnecessary water production and implications for

- exploration and timing of biogenic gas. *International Journal of Coal Geology*, 126,106-119, doi:10.1016/j.coal.2013.10.006.
- McLaughlin, J.F., Bagdonas, D., Frost, C.D., Frost, B.R., 2013, *Geologic Map of the Stampede Meadows quadrangle, Fremont County, Wyoming*. Wyoming State Geological Survey Bedrock Geologic Map, 1:24,000 scale.
- McArthur, K.L., Frost, C.D., Barnes, C.G., Prestvik, T., Nordgulen, Ø., 2013, Tectonic reconstruction and sediment provenance of a far-traveled oceanic nappe, Helgeland Nappe Complex, west-central Norway. *Journal of the Geological Society of London*, doi 10.1144/SP390.3
- Marko, W.T., Barnes, C.G., Yoshinobu, A.S., Frost, C.D., Nordgulen, Ø., 2013, Geology, geochemistry, and emplacement conditions of the Vega intrusive complex: an example of large-scale crustal anatexis in north-central Norway. *Journal of the Geological Society of London*, doi 10.1144/SP390.x.
- Mailloux, J., Ogle, K., Frost, C.D., 2013, Using a Bayesian statistical model to determine the amount of coal bed natural gas coproduced water in the Powder River, Wyoming and Montana. *Hydrologic Processes*, doi: 10.1002/hyp9784.
- Frost, C.D., and Frost, B.R., 2013, Proterozoic Intraplate Ferroan Magmatism. *Precambrian Research*, v. 228. p. 151-163.
- Quillinan, S.A., and Frost, C.D., 2012, Spatial variability of coalbed natural gas produced water quality, Powder River Basin, Wyoming: implications for future development. *Wyoming State Geological Survey Report of Investigation* No. 64, 58 pp.
- Dall'Agnol, R., Frost, C.D., and Ramo, T., 2012, IGCP Project 510 "A-type granites and related rocks through time": project vita, results and contribution to granite research. *Lithos*, v. 151, p.1-16.
- Quillinan, S.A., McLaughlin, J.F., Frost, C.D., 2012, Geochemical and stable isotopic analysis of the Tongue River and associated tributaries in the Powder River Basin: an analysis of the cause of annual elevated salinity in spring runoff. *Wyoming State Geological Survey Report of Investigation* No. 63, 15 pages.
- Barnes, C.G., Frost, C.D., Nordgulen, O., Prestvik T., 2012, Magma hybridization in the middle crust, possible consequences for MASH magmatism. *Geosphere*, v. 8, 518-533.
- Barnes, C.G., Reid, K., Frost, C.D., Barnes, M.A., Allen, C.M., and Yoshinobu, A.S., 2011, Ordovician and Silurian magmatism in the Upper Nappe, Uppermost Allochthon, Helgeland Nappe Complex, north-central Norway. *Norwegian Journal of Geology*, 91, p. 121-136.
- Frost, C.D., and Mailloux, J.M., 2011, Establishing appropriate water quality numeric standards

- under the Clean Water Act: lessons from a case study of coalbed methane produced water discharge to the Powder River, Wyoming and Montana. *Wyoming Law Review*, v. 11, no. 1, 1-23.
- Schwartz, J. J. Snoke, A.W., Cordey, F., Johnson, K., Frost, C.D., Barnes, C.G., LaMaskin, T.A., Wooden, J.L., 2011, Late Jurassic Magmatism, Metamorphism and Deformation in the Blue Mountains Province, northeast Oregon. *Geological Society of America Bulletin*, v. 123, p 2083-2111.
- Nelson, S.T., Hart, G.L., Frost, C.D., 2011, A reassessment of Mojavia and a new Cheyenne Belt alignment in the eastern Great Basin. *Geosphere* 7, no. 2, p. 513-527.
- McLaughlin, J.F., Frost, C.D., Sharma, S., 2011, Isotopic analysis of Atlantic Rim waters, Carbon County, Wyoming: a new tool for characterizing coalbed natural gas systems. *American Association of Petroleum Geologists Bulletin*, v. 95, p. 191-217.
- Frost, C.D., and Frost, B.R., 2011, On ferroan (A-type) granites: their compositional variability and modes of origin. *Journal of Petrology* 52, 39-53.
- Campbell-Stone, E., Lynds, R., Frost, C., Becker, T.P., and Diem, B., 2010. The Wyoming carbon underground storage project: geologic characterization of the Moxa Arch and Rock Springs Uplift. *Energy Procedia*, v. 00, p. 00.
- Frost, C.D. and Jakle, A.C., 2010, Geologic carbon sequestration in Wyoming: prospects and progress. *Rocky Mountain Geology*, v. 45, p. 83-91.
- Lynds, R., Campbell-Stone, E., Becker, T.P., Frost, C. 2010, Stratigraphic evaluation of reservoir and seal in a natural CO<sub>2</sub> field: Lower Paleozoic, Moxa Arch, southwest Wyoming. *Rocky Mountain Geology*, v. 45, p. 113-132.
- Smith, M.S., Sharma, S., Wyckoff, T.B., and Frost, C.D., 2010, Baseline Geochemical Characterization of Potential Receiving Reservoirs for Carbon Dioxide in the Greater Green River Basin, Wyoming. *Rocky Mountain Geology*, v. 45, p. 93-111.
- Stewart, E.D., Link, P.K., Fanning, C.M., Frost, C.D., McCurry, M., 2010, Non-North American sediment in the Mesoproterozoic upper Belt Supergroup and Lemhi Group: new constraints on a proto-Rodinia. *Geology*, v, 38, 927-930.
- Frost, C.D., Brinck, E.L., Mailloux, J., Sharma, S., Campbell, C.E., Carter, S.A., Pearson, B.N., 2010, Innovative approaches for tracing water co-produced with coalbed natural gas: applications of strontium and carbon isotopes of produced water in the Powder River Basin, Wyoming and Montana (invited). In K.J. Reddy (ed.) *Coalbed Methane: Energy and Environment*, Nova Science Publishers, New York, p 59-80.
- Frost, C.D., Frost, B.R., Lindsley, D.H., Chamberlain, K.R., Swapp, S.M., Scoates, J.S., 2010, Geochemical and isotopic evolution of the anorthositic plutons of the Laramie anorthosite

complex: explanations for variations in silica activity and oxygen fugacity of massif anorthosites. *Canadian Mineralogist*, v. 48, 925-946.

Lindsley, D.H., Frost, B.R., Frost, C.D., Scoates, J.S., 2010, Petrology, geochemistry, and structure of the Chugwater anorthosite, Laramie Anorthosite complex, S.E. Wyoming, U.S.A. *Canadian Mineralogist*, v. 48, 887-923.

Schwartz, J.J., Snoke, A.W., Frost, C.D., Barnes, C.G., Gromet, L.P., Johnson, K., 2010, Structural and isotopic characteristics of the Wallowa-Baker terrane boundary: evidence for a lithospheric terrane boundary in the Blue Mountains Province, northeast Oregon. *Geological Society of America Bulletin*, v. 122, 517-536, doi:10.1130/B26493.1.

Brinck, E.L., Frost, C.D., 2009, Evaluation of amendments used to prevent sodification of irrigated fields. *Applied Geochemistry*, v. 24, p. 2113-2122, doi:10.1016/j.apgeochem.2009.09.001.

Frost, B.R., and Frost, C.D., 2009, On Charnockites. Reply to Discussion by C. Bhattacharyya and B. Goswami. *Gondwana Research*, doi:10.1016/j.gr.2008.09.003

Fenner, J.N., and Frost, C.D. 2009, Modern Wyoming plant and pronghorn isoscapes and their implications for archaeology. *Journal of Geochemical Exploration*, v. 102, p 149-156. Doi:10.1016/j.gexplo.2008.09.003.

Barnes, C.G., Prestvik, T., Li, Y., McCulloch, L., Yoshinobu, A.S., Frost, C.D., 2009, Growth and zoning of the Hortavær intrusive complex, a layered alkaline pluton in the Norwegian Caledonides. *Geosphere* v.5, p 286-301; doi: 10.1130/GES00210.1.

Frost, B.R., and Frost, C.D., 2008, A geochemical classification for feldspathic rocks. *Journal of Petrology*, v. 49 no. 11, 1955-1969. Doi:10.1093/petrology/egn054.

Campbell, C.E., Pearson, B.N., and Frost, C.D. 2008, Strontium isotopes as indicators of aquifer communication in an area of coal bed natural gas production, Powder River Basin, Wyoming and Montana. *Rocky Mountain Geology*, v. 43, no. 2, 149-175.

Brinck, E.L., Drever, J.I., and Frost, C.D., 2008, The geochemical evolution of water co-produced with coal bed natural gas in the Powder River Basin, Wyoming. *Environmental Geosciences* v. 15, no. 4, p. 153-171. Doi:10.1306/eg.01290807017.

Nordgulen, Ø, Barnes, C., Yoshinobu, A., Frost, C., Prestvik, T., Austrheim, H., 2008, Pre-Scandian tectonic and magmatic evolution of the Helgeland Nappe Complex, Uppermost Allocthon. Field guide for 33 IGC excursion No. 35, August 1-5, 2008, 75 p.

Sharma, S., and Frost, C.D., 2008, Tracing coal bed natural gas co-produced water using stable isotopes of carbon. *Ground Water*, v. 46, 329-334.

Frost, B.R., and Frost, C.D., 2008, On Charnockites. *Gondwana Research* 12, 30-44. doi:10.1016/j.gr.2007.07.006.

- Barnes, C.G., Frost, C.D., McArthur, K., Barnes, M.A., Allen, C.M., Nordgulen, Ø., Prestvik, T., and Yoshinobu, A.S., 2007, Timing of sedimentation, metamorphism, and plutonism in the Helgeland Nappe Complex, north-central Norwegian Caledonides. *Geosphere* v.3: 683-703 doi:10.1130/GES00138.1.
- Brinck, E.L., and Frost, C.D. 2007. Detecting infiltration and impacts of introduced water using strontium isotopes. *Ground Water*, v. 45: 554-569, doi:10.1111/j.1745-6584.2007.00345.x.
- Frost, C.D., von Blanckenburg, F., Schoenberg, R., Frost, B.R., and Swapp, S.M. 2007. Preservation of Fe isotope heterogeneities during diagenesis and metamorphism of banded iron formation. *Contributions to Mineralogy and Petrology*, v. 153: 211-235, doi 10.1007/s00410-006-0141-0.
- Frost, C.D., Rämö, O.T., Dall'Agnol, R., 2007. Preface: IGCP project 510—A-type granites and related rocks through time. *Lithos*, v. 97: vii-xiii. doi: 10.1016/j.lithos.2006.11.006.
- Vijaya Kumar, K., Frost, C.D., Frost, B.R., Chamberlain, K.R., 2007. The Chimakurti-Errakonda-Uppalapadu Plutons, Eastern Ghats Belt, India: An unusual association of tholeiitic, and alkaline magmatism. *Lithos*, v. 97: 30-57, doi: 10.1016/j.lithos.2006.11.008.
- Li, Y., Barnes, M.A., Barnes, C.G., Frost, C.D., 2007. Grenville-age A-type and related magmatism in southern Laurentia, Texas and New Mexico, USA. *Lithos*, v. 97: 58-87, doi: 10.1016/j.lithos.2006.12.010.
- Mueller, P.A., and Frost, C.D., 2006. The Wyoming province: a distinctive Archean craton in Laurentian North America. *Canadian Journal of Earth Sciences*, v. 43, 1391-1397.
- Frost, C.D., Frueh, B.L., Chamberlain, K.R., Frost, B.R., 2006. Archean crustal growth by lateral accretion of juvenile supracrustal belts in the south-central Wyoming province. *Canadian Journal of Earth Sciences*, v. 43, 1533-1555.
- Frost, C.D. and Fanning, C.M., 2006. Archean geochronological framework of the Bighorn Mountains, Wyoming. *Canadian Journal of Earth Sciences*, v. 43, 1399-1418.
- Souders, A.K. and Frost, C.D., 2006. In suspect terrane? Provenance of the Late Archean Phantom Lake Metamorphic Suite, Sierra Madre, Wyoming. *Canadian Journal of Earth Sciences*, v. 43, 1557-1577.
- Frost, C.D., Frost, B.R., Kirkwood, R., Chamberlain, K.R., 2006. The tonalite-trondhjemite-granodiorite (TTG) to granodiorite-granite (GG) transition in the Late Archean plutonic rocks of the central Wyoming province. *Canadian Journal of Earth Sciences*, v. 43, 1419-1444.
- Frost, B.R., Frost, C.D., Cornia, M., Chamberlain, K.R., Kirkwood, R., 2006. The Teton-Wind River domain: a 2.68-2.67 Ga active margin in the western Wyoming province. *Canadian Journal of Earth Sciences*, v. 43, 1489-1510.

- Grace, R.L.B., Chamberlain, K.R., Frost, B.R., and Frost, C.D., 2006, Tectonic histories of the Paleo- to Mesoproterozoic Sacawee Block and Neoproterozoic Oregon Trail structural belt of the south-central Wyoming province. *Canadian Journal of Earth Sciences*, v. 43, 1445-1466.
- Frost, C.D., Barnes, C.G., and Snoke, A.W., 2006, Nd and Sr isotopic data from argillaceous rocks of the Galice Formation and Rattlesnake Creek terrane, Klamath Mountains: evidence for the input of Precambrian sources. In A.W. Snoke and C.G. Barnes, eds., Geological studies in the Klamath Mountains province, California and Oregon, *Geological Society of America Special Paper* 410, 103-120.
- Bushey, J.C., Snoke, A.W., Barnes, C.G., and Frost, C.D., 2006, Evolution of an oceanic-arc plutonic suite: Bear Mountain intrusive complex, Klamath Mountains, California. In A.W. Snoke and C.G. Barnes, eds., Geological studies in the Klamath Mountains province, California and Oregon, *Geological Society of America Special Paper* 410, p. 287-315.
- Barnes, C.G., Snoke, A.W., Harper, G.D., Frost, C.D., McFadden, R., Bushey, J.C., and Barnes, M.A.W., 2006, Nascent arc plutonism following regional thrusting: petrology and geochemistry of post-Nevadan plutons in the Siskiyou Mountains, Klamath Mountain province, California. In A.W. Snoke and C.G. Barnes, eds., Geological studies in the Klamath Mountains province, California and Oregon, *Geological Society of America Special Paper* 410, 357-376.
- Barnes, C.G., Mars, E.V., Swapp, S.M., Frost, C.D., 2006, Petrology and geochemistry of the Middle Jurassic Ironside Mountain batholith: evolution of potassic magmas in a primitive arc setting. In A.W. Snoke and C.G. Barnes, eds., Geological studies in the Klamath Mountains province, California and Oregon, *Geological Society of America Special Paper* 410, p. 199-221.
- Stoeser, D.B., and Frost, C.D., 2006. Nd, Pb, Sr, and O isotopic characterization of the Saudi Arabian Shield terranes. *Chemical Geology*, v. 226, 163-188.
- Frost, C.D., McCurry, M., Christiansen, R., Putirka, K., Kuntz, M., 2005, Extrusive A-type magmatism of the Yellowstone Hot Spot Track. Field trip guidebook for Field Trip AC-4, 15<sup>th</sup> Goldschmidt Conference, May 26-30, 2005. 27 pages plus appendices.
- Frost, C.D., Mortimer, N., and Gole, G.G., 2005. Nd isotopic anatomy of a pebble conglomerate from the Murihiku terrane of New Zealand: a record of varied provenance along the Mesozoic Gondwanaland margin. *Journal of Sedimentary Geology*, v. 182, 201-208.
- Frost, C.D., and Brinck, E., 2005, Strontium isotopic tracing of the effects of coal bed natural gas (CBNG) development on shallow and deep groundwater systems in the Powder River Basin, Wyoming. Wyoming State Geological Survey Report of Investigations 55, p. 93-107.
- Frost, C.D., and Toner, R.N., 2004, Strontium isotopic identification of water-rock interaction and groundwater mixing. *Ground Water*, v. 42, 418-432.
- Gosselin, D.C., Harvey, F.E., Frost, C.D., Stotler, R., and Macfarlane, P.A., 2004, Strontium isotope



- geochemistry of groundwater in the central part of the Dakota (Great Plains) aquifer, U.S.A. *Applied Geochemistry*, v. 19, p. 359-377.
- Chamberlain, K.R., Frost, C.D., and Frost, B.R., 2003, Early Archean to Mesoproterozoic evolution of the Wyoming province: Archean origins to modern lithospheric architecture. *Canadian Journal of Earth Sciences*, v. 40, p. 1357-1374.
- Anderson, I.C., Frost, C.D., Frost, B.R., 2003, Petrogenesis of the Red Mountain pluton, Laramie anorthosite complex, Wyoming: implications for the origin of A-type granite. *Precambrian Research*, v. 124, 243-267.
- Lee, S-Y, Barnes, C.G., Snoke, A.W., Howard, K.E., and Frost, C.D., 2003, Petrogenesis of Mesozoic, peraluminous granites of the Lamoille Canyon area, Ruby Mountains, Nevada USA. *Journal of Petrology*, v. 44, 713-732.
- Toner, R.N., Frost, C.D., Chamberlain, K.R., 2003, Isotopic identification of natural vs. anthropogenic sources of Pb in Laramie basin groundwaters, Wyoming, USA. *Environmental Geology*, v. 43, p. 580-591.
- Frost, C.D., Frost, B.R., Bell, J.M., Chamberlain, K.R., 2002, The relationship between A-type granites and residual magmas from anorthosite: evidence from the northern Sherman batholith, Laramie Mountains, Wyoming, USA. *Precambrian Research*, v. 119, p. 45-71.
- Frost, C.D., Pearson, B.N., Ogle, K.M., Heffern, E.L., Lyman, R.M., 2002, Sr isotopic tracing of aquifer interactions in an area of coal and methane production, Powder River Basin, Wyoming. *Geology*, v. 30, p. 923-926.
- Frost, C.D., Viergets, J.E., Pearson, B.N., Heffern, E.L., Lyman, R.M., and Ogle, K.M., 2002, Sr isotopic identification of coal and sandstone aquifers and monitoring of aquifer interactions in an area of active coal bed methane production, Powder River Basin, Wyoming. Wyoming Geological Association Fifty Second Field Conference, p. 107-121.
- Myers, J.D., Marsh, B.D., Frost, C.D., Linton, J.A., 2002, Petrologic constraints on the spatial distribution of crustal magma chambers, Atka Volcanic Center, central Aleutian arc. *Contributions to Mineralogy and Petrology*, v. 143, p. 567-586.
- Frost, C.D., 2002, Katharine Fowler-Billings: pioneering woman field geologist trained in the Rocky Mountains. *Rocky Mountain Geology*, v. 37, p. 99-102.
- Frost, C.D., Bell, J.M., Frost, B.R., and Chamberlain, K.R., 2001, Crustal growth by magmatic underplating: isotopic evidence from the northern Sherman batholith. *Geology*, v. 29, p. 515-518.
- Frost, B.R., Arculus, R.J., Barnes, C.G., Collins, W.J., Ellis, D.J., and Frost, C.D., 2001, A geochemical classification of granitic rock suites. *Journal of Petrology*, v. 42, 2033-2048. [In January 2014, this was the 12<sup>th</sup> most cited paper published by *Journal of Petrology*]

- Gosselin, D.C., Harvey, F.E., and Frost, C.D., 2001, Hydrogeochemistry of the Great Plains (Dakota) aquifer in Nebraska. *Ground Water*, v 39, p. 98-108.
- Frost, B.R., Frost, C.D., Hulsebosch, T.P., Swapp, S.M., 2000, Origin of the charnockites of the Louis Lake Batholith, Wind River Range, Wyoming. *Journal of Petrology*, v.41, p. 1759-1776.
- Anderson, S.P., Drever, J.I., Frost, C.D., and Holden, P., 2000, Chemical weathering in the foreland of a retreating glacier. *Geochimica et cosmochimica acta*, v. 64, 1173-1189.
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- Cox, D. N., Frost, C.D., Chamberlain, K.R., 2000, 2.01 Ga mafic dike swarm, SE Wyoming: record of a rifted margin along the southern Wyoming province. *Rocky Mountain Geology*, v. 35, no.1, p. 7-30.
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- Frost, B.R., Chamberlain, K. R., Swapp, S., Frost, C.D., and Hulsebosch, T.P., 2000, Late Archean structural and metamorphic history of the Wind River Range: Evidence for a long-lived active margin on the Archean Wyoming craton. *Geological Society of America Bulletin*, v. 112, p. 564-578.
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## CONTRACTS AND GRANTS

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“Dr. John C. Reed, Jr., pioneering geologist, mountaineer, and author of *Creation of the Teton Landscape*.” C. Frost, University of Wyoming/National Park Service research program, \$3,757, 5/1/13 to 4/30/14.

“The mineralogy and provenance of Wyoming uranium roll-front deposits and their significance to in-situ recovery mining processes.” S. Swapp, R. Frost, R. Gregory, J. McLaughlin, C. Frost. WYDEQ/School of Energy Resources. \$227,449. 7/1/11-6/30/14.

“Early Earth tectonics and uranium source rocks: mapping the Archean geology of the Granite Mountains, Central Wyoming Province.” C. Frost, R. Frost. U.S. Geological Survey EDMAP program, \$21,411 from agency, 6/1/11 to 5/31/12.

“Acquisition of a MC-ICPMS for the University of Wyoming.” Sims, K., Chamberlain, K., Frost, C. National Science Foundation MRI-0960270. \$874,225. 6/1/2010.

“Site Characterization of the highest-priority geologic formations for CO<sub>2</sub> storage in Wyoming.” C. Frost, Principal Investigator. Department of Energy National Energy Technology Laboratory. \$4,975,000 plus \$11,900,000 from industry, state and other sources. 1/1/2010-12/31/2012. (Note: PI transferred from Frost to R. Surdam on 2/1/2010 when Surdam was hired as Director of Carbon Management at the School of Energy Resources.)

“CO<sub>2</sub> sequestration in depleted compartmentalized gas fields—the key to deploying clean coal technology in the Powder River Basin, Wyoming.” R. Surdam, Principal Investigator and Carol Frost, co-P.I. for \$452,760 subcontract to UW from Wyoming State Geological Survey. Clean Coal Technologies Research Program, School of Energy Resources. Total project: \$500,000 from CCTRP and \$500,000 from other sources. (Note: C. Frost ceased serving as co-PI when R. Surdam was hired into UW’s School of Energy Resources where he administers the UW subcontract.)

“Carbon sequestration monitoring activities.” C. Frost, Principal Investigator. Department of Energy National Energy Technology Laboratory. \$823,000. 9/1/2009-11/30/2010.

“Carbon sequestration monitoring activities.” C. Frost, Principal Investigator. Department of Energy National Energy Technology Laboratory. \$1,558,470. 9/1/2008-8/30/2009.

“A new method for tracing seepage from CBNG water holding ponds in the Powder River Basin, Wyoming.” S. Sharma, K.J. Reddy, C. Frost, Wyoming Water Research Program Competitive Grant Program, \$46,883, 3/1/08 to 2/28/10.

“A vital link for the reconstruction of terranes of the North American Cordillera: the Baker Terrane, NE Oregon. (A.W. Snoke and C.D. Frost) NSF EAR0610084, \$183,635, 06/1/07-5/31/12.

“Environmental tracers applied to quantifying impact of CBNG-related water production on surface and

- ground water and soil in the Powder River Basin, Wyoming. C. D. Frost. DOE 42605Task4 \$240,621, 6/02/06-5/31/08.
- “Atlantic Rim Water Connectivity Analysis” C.D. Frost. BLM DOI/BLM41930 \$6,800 7/24/06-9/1/07.
- “High pressure granulite metamorphism in the Tetons: the earliest record of Himalayan-style tectonics?” (B.R. Frost, C. D. Frost and S. Swapp) NSF EAR 0537670, \$215, 939 6/1/06-5/30/12.
- “Collaborative Research: Magma-host rock interaction processes of assimilation in the mid-crustal Hortavaer Intrusive Complex, north-central Norway.” C.D. Frost. NSF EAR 0439698, \$167,557, January 1, 2005-December 31, 2008.
- “Produced water management and beneficial use: subtask 3.0, isotopic evaluation of CBM-produced waters” C.D. Frost. DOE 4251/11401/COMINES47865GEO, \$174,724, May 1, 2005 to October 31, 2007.
- “IGCP-510: A-type Granites and Related Rocks Through Time” R. Dall’Agnol, C. Frost, T. Ramo, co-chairs, UNESCO IGCP Secretariat. \$25,000, 4/05-4/11 (administered from University of Helsinki, provides funding for developing country geologists to participate in annual field conferences.)
- “Tectonic evolution of the high pressure granulites in the Tetons.” B.R. Frost and C.D. Frost. UW/NPS 49182, \$4400, March 1, 2005 to December 31, 2007.
- “Sr isotopic tracing of the effects of coal bed methane development on shallow and deep groundwater systems in the Powder River basin, Wyoming.” C.D. Frost. Western Research Project Foundation, \$72,014, 7/02-7/03.
- “Re-Os systematics in Proterozoic anorthosite complexes.” J.L. Hannah, C.D. Frost, H.J. Stein. NSF EAR 0106874, \$195,000, 7/01-7/03. (UW portion \$12,200.)
- “Sr isotopic characterization of coal and sandstone aquifers, Powder River Basin, Wyoming.” C. D. Frost, K.M. Ogle, R. M. Lyman and E. Heffern. Abandoned Coal Mine Lands Research Program, administered by Wyoming Dept. of Environmental Quality, \$95,674, 6/00–5/02
- “Late Archean crustal evolution of the Wyoming province.” C.D. Frost, K.R. Chamberlain, B.R. Frost. NSF EAR9909260, \$225,135. 5/00-4/04.
- “Crustal recycling versus crustal addition: the role of underplated tholeiitic rocks in the origin of reduced, rapakivi-type granites” C.D. Frost and B.R. Frost. NSF EAR-9706237, \$102,000. 6/97-5/00.
- “Acquisition of a thermal ionization mass spectrometer.” C.D. Frost. NSF EAR-9601783, \$250,000. 8/96-8/98.
- “Monitoring groundwater quality using Sr isotopes: three case studies in Wyoming.” C.D. Frost and K.R. Chamberlain. Wyoming Water Resources Center 5-39884, \$24,000. 7/1/96-12/31/98.



- "Processes of isotopic resetting in the contact aureole of the Laramie Anorthosite Complex." C.D. Frost, K.R. Chamberlain, B.R. Frost. NSF EAR9218458, \$90,000. 6/93-5/95.
- "Collaborative Research: Petrogenesis of the Laramie Anorthosite Complex." B.R. Frost and C.D. Frost. NSF EAR-9218360, \$134,999. 1/93-1/96.
- "Collaborative Research: Petrogenesis of the Laramie Anorthosite Complex." B.R. Frost and C.D. Frost. NSF EAR-9017465, \$94,854. 3/91-9/93.
- "Upgrading of a thermal ionization mass spectrometer." C.D. Frost. NSF EAR-8916365, \$92,725. 4/90-10/91.
- "Tectonic and petrologic controls on arc magmatic processes and magma evolution: Segum Island, Aleutian arc, Alaska." J.D. Myers and C.D. Frost. NSF EAR-8917354, \$32,200. 7/90-12/92.
- "The origin of bimodal volcanic suites: a study of Newberry Volcano, Oregon." J.D. Myers and C.D. Frost. NSF EAR-9004042, \$64,900. 6/89-12/91.
- "Collaborative research: petrogenesis of the Laramie Anorthosite Complex." B.R. Frost and C.D. Frost. NSF EAR-8816604, \$74,000. 2/89-2/91.
- "Neodymium isotopes: a potential geochemical tracer for petroleum exploration." C.D. Frost. Petroleum Research Fund, \$40,000. 1/88-8/91.
- "Processes of granulite formation and their geochemical signatures: a study in the Wind River and Laramie Mountains, Wyoming." C.D. Frost and B.R. Frost. NSF EAR-8707296, \$80,000. 8/87-2/90.
- "Collaborative research: petrogenesis and structure of the Laramie Anorthosite Complex and its aureole." B.R. Frost and C.D. Frost. NSF EAR-8617812, \$110,810. 2/87-8/89.
- "Development of a program in geochemistry and isotope geology at the University of Wyoming." C.D. Frost. Atlantic Richfield Foundation, \$60,000. 1/85-3/86.
- "Petrotectonic evolution of Tobago, West Indies." A.W. Snoke, C.D. Frost, G. Wadge, and W.D. Sharp. NSF EAR-8418139, \$149,957. 12/84-5/88.
- "Geochemical and petrologic studies of the amphibolite-granulite transition in Archean rocks of the Wind River Mountains, Wyoming." C.D. Frost and B.R. Frost. NSF EAR-8408357, \$97,500. 11/84-4/87.
- "Acquisition of a low-cost thermal ionization mass spectrometer." C.D. Frost. NSF EAR-8408444, \$40,000. 9/84-2/86.

"Study of Archean granites and associated metasediments." C.D. Frost. P.M. McKenna Foundation, Inc., \$15,000. 6/84.

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## TEACHING

My primary assignments have been teaching geochemistry, isotope geology, and an introductory level (1000 or 2000) course each year. Courses taught include: GEOL 1000 Earth Science and Society, GEOL 1100 Physical Geology, GEOL 2000 Foundations of Geology I: Earth System Science, GEOL 2020 Petrology, GEOL 4060 Rocky Mountain Field trip, GEOL 4200 Planetary Geology, GEOL 4490 Geochemistry, GEOL 5050 Isotope Geology, and various seminar courses.

## Graduate Students and Post-doctoral Research Associates under my supervision

Student	Degree	Date Awarded	Title
Steven W. Lawrence	Senior Thesis	1987	Sm-Nd and Rb-Sr isotope geochemistry of a Late Archean supracrustal belt, central Wind River Mountains, Wyoming
Deborah K. Grisham	Senior Thesis	1987	Rb-Sr and Sm-Nd geochronology of a Late Archean granite, central Wind River Mountains, Wyoming
Leslie K. Manning	M.S.	1988	Neodymium isotopes: a source rock-oil correlation tool
Ann Lundberg	Senior Thesis	1989	The Geologist and the Great West: Geological Survey of the Territories under F.V. Hayden
Bradley S. Singer	PhD	1990	Petrology and geochemistry of Mid-Pleistocene lavas from Seguam Island, central Aleutian Islands, Alaska (joint with J.D. Myers)
Scott R. Linneman	PhD	1990	Petrologic evolution of Holocene magmatic system of Newberry Volcano, central Oregon (joint with J.D. Myers)
Anthony R. Hoch	M.S	1991	Petrological and geochemical evolution of the Rattlesnake Hills Alkaline Intrusive complex, Natrona County, Wyoming (joint with J.D. Myers)
Thomas Hulsebosch	PhD	1993	Aspects of crustal evolution in the Archean Wind River Range, Wyoming (joint with B.R. Frost)
Benjamin R. Edwards	M.S.	1993	Field, geochemical and isotopic investigation of the igneous rocks in the Pole Mountain area of the Sherman batholith, southern Laramie Mountains, Wyoming
Jeremy N. Mitchell	PhD	1993	Petrology and geochemistry of dioritic and

			gabbroic rocks in the Laramie anorthosite complex, Wyoming
Lisa A. Verts	M.S.	1995	U-Pb sphene geochronology used to date multiple metamorphic events in the contact aureole of the Red Mountain pluton, southeastern Wyoming
Phillip G. Resor	M.S.	1996	Nature and timing of deformation associated with the Proterozoic Laramie Peak shear zone, Laramie Mountains, Wyoming (joint with A.W. Snoke)
Keith A. Krugh	M.S.	1997	U-Pb thermochronologic constraints on the early Proterozoic tectonic evolution of the Hartville Uplift, southeast Wyoming
Jennifer M. Bell	M.S.	1998	Petrologic, geochemical and isotopic investigation of the Mule Creek-Richeau Hills portion of the Sherman batholith, Laramie, Wyoming
David M. Cox	M.S.	1999	Geology, geochronology and geochemistry of the 2.01 Ga Kennedy mafic dike swarm: tectonic implications for the southern Wyoming province
Rachel N. Toner	M.S.	2000	Sr and Pb isotopic investigations of aquifer systems in the Laramie and Bighorn basins, Wyoming
Robert Kirkwood	M.S.	2000	Geology, geochronology and economic potential of the Archean rocks in the western Owl Creek Mountains, Wyoming (joint with K.R. Chamberlain)
Jami Viergets	Senior thesis	2002	Sr isotopes in shallow aquifers at Jacobs Ranch Mine, Powder River Basin
Kruckenberger, Seth C.	Senior honors thesis	2002	One billion years of Archean crustal evolution, Black Rock Mountain, northeastern Granite Mountains
Benjamin L. Fruchey	M.S.	2002	Archean supracrustal sequences of contrasting origin: the Archean history of the Barlow Gap area, northern Granite Mountains, Wyoming
Mary E. Cornia	M.S.	2003	The Archean History of the Teton Range and surrounding areas, Wyoming and Idaho
A. Kate Souders	M.S.	2004	In suspect terrane? Provenance of the Late Archean Phantom Lake metamorphic suite, Sierra Madre, Wyoming
Emily N. Wall	M.S.	2004	Petrogenesis of ~2.6 Ga post-tectonic granitoids of the central Wyoming province (joint with K.R. Chamberlain)

Meredith, Michael	M.S.	2005	Geology of Archean rocks of the Tin Cup Mountain area, Wyoming (joint with B.R. Frost)
Catherine Campbell	M.S.	2007	Strontium isotopes as tracers of water co-produced with coal bed natural gas in the Powder River Basin, Wyoming
Kelsey McArthur	M.S.	Dec. 2007	Nd and Sr isotopic data on ophiolite fragments and overlying supracrustal rocks in the Sauren-Torghatten nappe, North-central Norway: a record of oceanic provenance
Elizabeth Brinck	PhD	Dec. 2007	The geochemical evolution of water co-produced with coal bed natural gas in the Powder River Basin, Wyoming: infiltration, impacts, and beneficial use
Shaun Carter	M.S.	June 2008	Environmental tracers applied to quantifying impact of CBNG-related water production on surface and ground water and soil in the Powder River Basin, Wyoming
Fred McLaughlin	M.S.	Aug. 2009	Connectivity analysis of aquifers on the Atlantic Rim, Great Divide Basin
Lee Finley-Blasi	M.S.	Dec. 2009	Petrogenesis of the Webb Canyon gneiss: a 2.67 Ga leucogranite associated with continent-continent collision in the Teton Range
Jason Mailloux	PhD	December 2011	Environmental tracers applied to quantifying impact of CBNG-related water production on surface and ground water and soil in the Powder River Basin, Wyoming
Scott Quillinan	M.S.	June 2012	Environmental isotopic tracers of CBNG-produced water, Powder River Basin and Atlantic Rim, Wyoming
Fred McLaughlin	PhD	June 2014 (anticipated)	Mesoarchean evolution of the Wyoming Province
Lynsey Spaeth	M.S.	December 2013	Anhydrite seals for carbon dioxide sequestration (jointly advised with E. Campbell-Stone)
Davin Bagdonas	M.S.	June 2014 (anticipated)	Petrogenesis of the Granite Mountains batholith, Wyoming

**Note:** many other students have done research in the radiogenic isotope lab under my supervision although their graduate committees were chaired by other faculty.

**Post-doctoral researchers:**

Dennis J. Geist, 1986-1988

Kevin R. Chamberlain, 1990-1996

Jack Fenner, 2007-2008

**Sabbatical visitors hosted:**

Dr. Bill Ranson, 1990-1991

Dr. Vijaya Kumar, 2003-2004